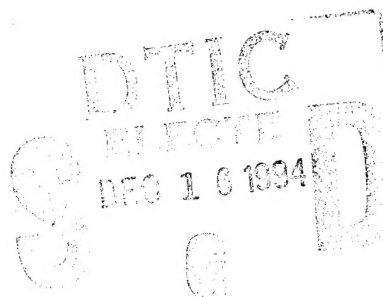


FINAL REPORT
JULY 1994

REPORT NO. 94-23

2,000-POUND MK84 BOMBS IN A COMMERCIAL ISO SIDE-OPENING CONTAINER TRANSPORTABILITY TESTS

19941212 006



Prepared for:
U.S. Army Defense Ammunition
Center and School
ATTN: SMCAC-DET
Savanna, IL 61074-9639

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U.S. ARMY
ARMAMENT
MUNITIONS
CHEMICAL COMMAND

U.S. ARMY DEFENSE AMMUNITION
CENTER AND SCHOOL

VALIDATION ENGINEERING DIVISION
SAVANNA, ILLINOIS 61074-9639

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

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| 19. ABSTRACT (Continue on reverse if necessary and identify by block number) | | | | | |
| <p>The U.S. Army Defense Ammunition Center and School (USADACS), Validation Engineering Division (SMCAC-DEV), was tasked by USADACS, Transportation Engineering Division (SMCAC-DET), to test a reduced wooden dunnage loading and bracing procedure for 2,000-pound MK84 bombs with fins on metal pallets in a commercial International Organization for Standardization (ISO) side-opening container. Rail impact, road, and container tilt tests were performed on a loaded commercial ISO side-opening container. The container was rail impact tested on a Trailer-on-Flatcar (TOFC). Road tests were performed with the container mounted on the M871 semitrailer (with the gross weight of the load exceeding transportation chassis limits.) Due to the Shipboard Transportation Simulator (STS) being inoperable, the container was tilted 80 degrees to the back wall with a crane. There was no damage to the load or the container as a result of these tests; therefore, this load is acceptable for transportation in all surface modes.</p> | | | | | |
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| 22a. NAME OF RESPONSIBLE INDIVIDUAL JEROME H. KROHN | | | 22b. TELEPHONE (Include Area Code) 815-273-8929 | | 22c. OFFICE SYMBOL SMCAC-DEV |

U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL
 VALIDATION ENGINEERING DIVISION
 SAVANNA, IL 61074-9639

REPORT NO. 94-23

2,000-POUND MK84 BOMBS IN A COMMERCIAL ISO SIDE-OPENING
 CONTAINER TRANSPORTABILITY TESTS

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PART 1

INTRODUCTION

A. BACKGROUND. The U.S. Army Defense Ammunition Center and School (USADACS), Validation Engineering Division (SMCAC-DEV), was tasked by USADACS, Transportation Engineering Division (SMCAC-DET), to test a reduced wooden dunnage loading and bracing procedure for 2,000-pound MK84 bombs as a complete round in a commercial International Organization for Standardization (ISO) side-opening container.

B. AUTHORITY. This test was conducted IAW mission responsibilities delegated by the U.S. Army Armament, Munitions and Chemical Command (AMCCOM), Rock Island, IL 61299-6000. Reference is made to AR-700, 15 April 1979, DARCOM Supplement 1, 4 September 1979; and AMCCOM-R 10-17, 13 January 1986, Mission and Major Functions of USADACS.

C. OBJECTIVE. The objective of these tests was to determine if the loading and bracing procedure with wooden dunnage in a commercial ISO side-opening container of 2,000-pound MK84 bombs, complete round would satisfy the transportation requirements of Transportability Testing Procedure, TP-91-01. The following tests were conducted: rail, road hazard course, washboard course, and container tilt test.

D. CONCLUSION. This loading and bracing procedure satisfactorily retained the 2,000-pound MK84 bombs and prevented damage to the container.

E. RECOMMENDATION. This procedure is recommended for approval for transportation of 2,000-pound MK84 bombs and fins in all surface modes.

PART 2

7 and 17 July 1994

ATTENDEES

A. C. McIntosh, Jr.
General Engineer
DSN 585-8989
815-273-8989

Dan Healy
Senior Inspector
708-392-6846
800-826-4662 (Answering Service)

Jerome H. Krohn
Supervisory General Engineer
DSN 585-8908
815-273-8908

Quinn D. Hartman
General Engineer
DSN 585-8992
815-273-8992

David V. Valant
Electronics Technician
DSN 585-8988
815-273-8988

Richard S. Haynes
Industrial Engineering Technician
DSN 585-8225
815-273-8225

Director
U.S. Army Defense Ammunition
Center and School
ATTN: SMCAC-DEV
Savanna, IL 61074-9639

Association of American Railroads
Bureau of Explosives
309 N. Douglas
Arlington Heights, IL 60004

Director
U. S. Army Defense Ammunition
Center and School
ATTN: SMCAC-DEV
Savanna, IL 61074-9639

Director
U. S. Army Defense Ammunition
Center and School
ATTN: SMCAC-DEV
Savanna, IL 61074-9639

Director
U. S. Army Defense Ammunition
Center and School
ATTN: SMCAC-DEV
Savanna, IL 61074-9639

Director
U. S. Army Defense Ammunition
Center and School
ATTN: SMCAC-DET
Savanna, IL 61074-9639

PART 3

TEST PROCEDURES

These procedures were extracted from TP-91-01, Transportability Testing Procedures, July 1991, for tactical vehicles used for shipping munitions by tactical truck.

A. The test load was prepared using the outloading procedure specified for the munitions (see part 6). The 2,000-pound MK84 bombs used in the load were inert (nonexplosive). The weight and physical characteristics of the load configuration were identical to the live (explosive) ammunition provided for in part 6; i.e., weights, physical dimensions, center of gravity (CG), etc. The ammunition packages duplicated live ammunition.

B. Tests for this load configuration are as follows:

1. Rail Impact (Test Method No. 1).
2. Road Hazard Course (Test Method No. 2).
3. Road Trip (Test Method No. 3).
4. Road Hazard Course (Test Method No. 2).
5. Washboard Course (Test Method No. 6).
6. Tilt Test (Test Method No. 5).

C. The test methods are as follows:

1. Test Method No. 1 (Rail Impact Test). The container load of 2,000-pound MK84 bombs was positioned on a container chassis and securely locked in place using the twist locks at each corner. The container chassis was secured to a Trailer-on-flatcar (TOFC). Equipment needed to perform the test included the TOFC (hammer) railcar, five empty railroad cars connected together to serve as the anvil, and a railroad locomotive. These anvil cars were

positioned on a level section of track with air and hand brakes set with draft gears compressed. The locomotive unit pulled the TOFC several hundred yards away from the anvil cars, pushed the TOFC toward the anvil at a predetermined speed, then disconnected from the TOFC approximately 50 yards away from the anvil cars, which allowed it to roll freely along the track until it struck the anvil. This constituted an impact. Impacting is accomplished at speeds of 4, 6, and 8.1 mph in the forward direction and at 8.1 mph in reverse. The 4 and 6 mph impact speeds are approximate; the 8.1 mph speed is a minimum. Impact speeds are determined by using an electronic counter to measure the time required for the TOFC to traverse an 11-foot distance immediately prior to contact with the anvil cars (see Figure 1, page 3-4).

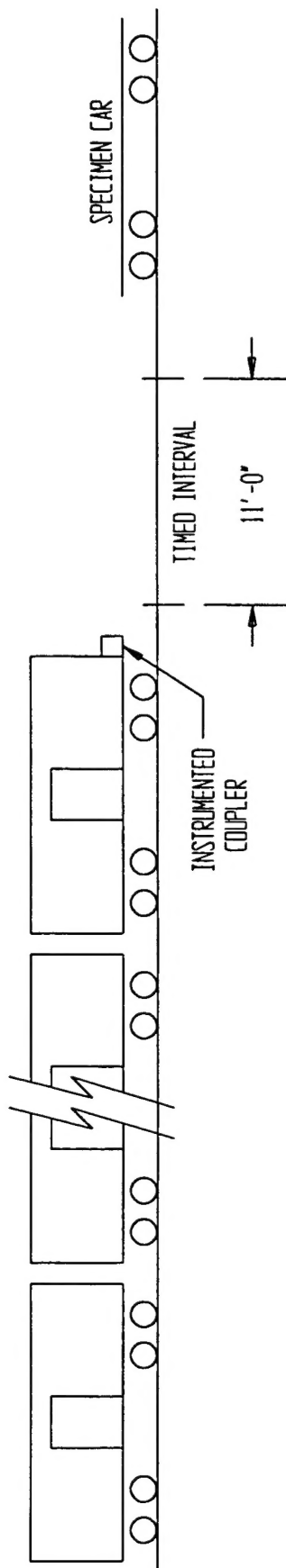
2. Test Method No. 2 (Road Hazard Course). This step required the container load of 2,000-pound MK84 bombs transported on the M871 semitrailer be pulled over a 200-foot-long segment of concrete road which consists of two series of railroad ties projecting 6-inches above the level of the road surface. The load traversed the course two times (see Figure 2, page 3-5).

3. Test Method No. 3 (Road Trip). The M871 semitrailer and container of 2,000-pound MK84 bombs was transported for a distance of 30 miles over a combination of roads surfaced with gravel, concrete, or asphalt. The test route included curves, corners, railroad crossings, cattle guards, and stops and starts. The load traveled at the maximum speed suitable for the particular road being traversed, except as limited by legal restrictions. No panic stops were performed since the test load was subjected to rail impact testing.

4. Test Method No. 6 (Washboard Course). A suitable tractor was used to pull the M871 semitrailer with the container load of 2,000-pound MK84 bombs over the 300-foot-long washboard course at a speed which produced the most violent response in the container load. The washboard course is constructed as shown in Figure 3, page 3-5.

5. Test Method No. 5 (80 Degree Tilt Test). The container load of 2,000-pound MK84 bombs was positioned on level terrain with the corner fittings resting on timbers so the entire container was supported by the corner fittings. The timbers were oriented parallel to the end rails of the container and extended 2 feet beyond the corner fittings on each side. Using one mobile crane and appropriate rigging, the container was rotated (tilted) using the bottom corner fittings as a fulcrum. The rigging (sling) was attached to the top corner fittings of the long side of the container. Tilting was accomplished by lifting the top corner fittings directly above the fulcrum. The crane boom was then positioned over the center of the container and the container was allowed to complete rotation to 80 degrees from where it started. The container was allowed to remain at the 80 degree tilt position for at least 1 minute, then the container was uprighted by reversing this procedure.

ASSOCIATION OF AMERICAN RAILROADS (AAR) STANDARD TEST PLAN



SPECIMEN CAR
IS RELEASED BY
SWITCH ENGINE TO

ATTAIN: IMPACT NO. 1 @ 4 MPH
IMPACT NO. 2 @ 6 MPH
IMPACT NO. 3 @ 8.1 MPH

THEN THE CAR IS REVERSED AND
RELEASED BY SWITCH ENGINE TO

ATTAIN: IMPACT NO 4. @ 8.1 MPH

5 BUFFER CARS (ANVIL) WITH DRAFT GEAR
COMPRESSED AND AIR BRAKES IN A SET
POSITION
ANVIL CARS TOTAL WT 250,000 LBS (APPROX)

FIGURE 1

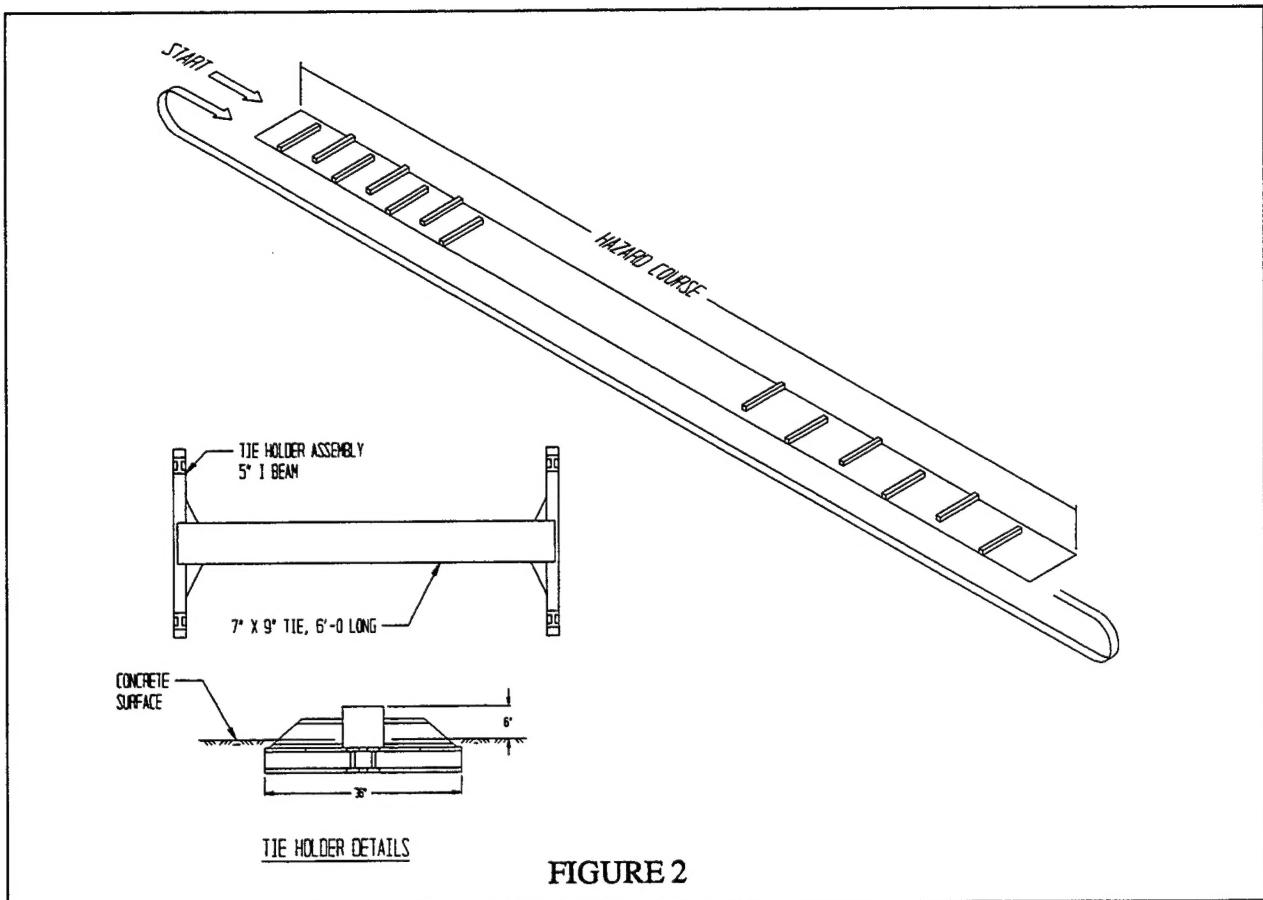


FIGURE 2

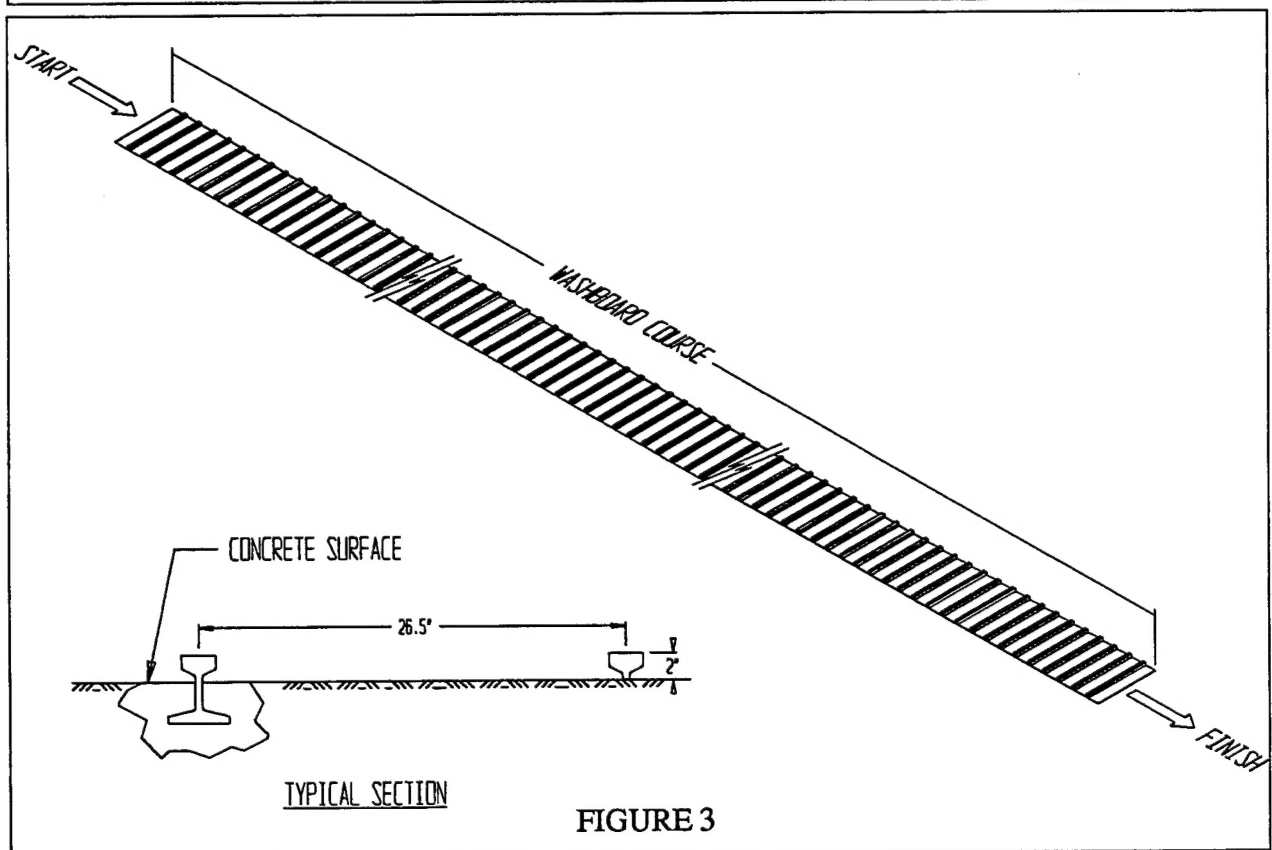


FIGURE 3

PART 4

TEST RESULTS

RAIL IMPACT DATA

Test No.: 1

Date: 7 July 1994

Specimen Load: 2,000-pound MK84 bombs on metal pallets and associated complete round components, loaded and braced with wooden dunnage in a commercial ISO side-opening container, chassis mounted on a TOFC.

TOFC No.: RTTX 153058

Lt. Wt.: 70,500

Chassis No.: ISCZ 164587

Wt.: 6,540

Container Type: ISO side-opening No.: USAF0014335

Wt.: 6,050

Load Type: 2,000-pound MK84 bombs, dunnage

Wt.: 43,543

Chassis No.: 5394

Wt.: 6,100

Container Type: ISO side-opening No.: USAF0013998

Wt.: 6,050

Load Type: 500-pound MK82 bombs, dunnage

Wt.: 38,265

Total Specimen Wt.: 176,548

Buffer Car (five cars) Wt.: 250,000

| <u>Impact</u> | <u>End Struck</u> | <u>Velocity</u> | <u>Remarks</u> |
|---------------|-------------------|-----------------|--|
| 1 | Forward | 4.21 | No load movement in either container. |
| 2 | Forward | 6.52 | No load movement in either container. |
| 3 | Forward | 8.33 | No longitudinal load movement in either container. Observed 1/2-inch vertical movement in center gate of 2,000-pound MK84 bombs. |
| 4 | Reverse | 8.41 | No Load movement. No additional vertical gate movement. |

ROAD TEST DATA

Test No.: 2

Date: 17 July 1994

Specimen Load: 2,000-pound MK84 bombs in an ISO side-opening container mounted on an M871 semitrailer.

ROAD HAZARD COURSE:

| | | |
|---|----------|---------|
| PASS 1-A OVER FIRST SERIES OF TIES: | 5.62 SEC | 6.1 MPH |
| PASS 1-B OVER SECOND SERIES OF TIES: | 5.72 SEC | 5.7 MPH |
| REMARKS: No damage to trailer or load movement. | | |

| | | |
|--------------------------------------|----------|---------|
| PASS 2-A OVER FIRST SERIES OF TIES: | 6.45 SEC | 5.2 MPH |
| PASS 2-B OVER SECOND SERIES OF TIES: | 6.19 SEC | 5.3 MPH |
| REMARKS: No damage or load movement. | | |

30-MILE ROAD TEST: No damage or load movement.

PANIC STOP TEST: No panic stops were performed since the container load was previously subjected to four rail impact tests.

| | | |
|--------------------------------------|----------|---------|
| PASS 3-A OVER FIRST SERIES OF TIES: | 5.82 SEC | 5.6 MPH |
| PASS 3-B OVER SECOND SERIES OF TIES: | 5.67 SEC | 5.7 MPH |
| REMARKS: No damage or load movement. | | |

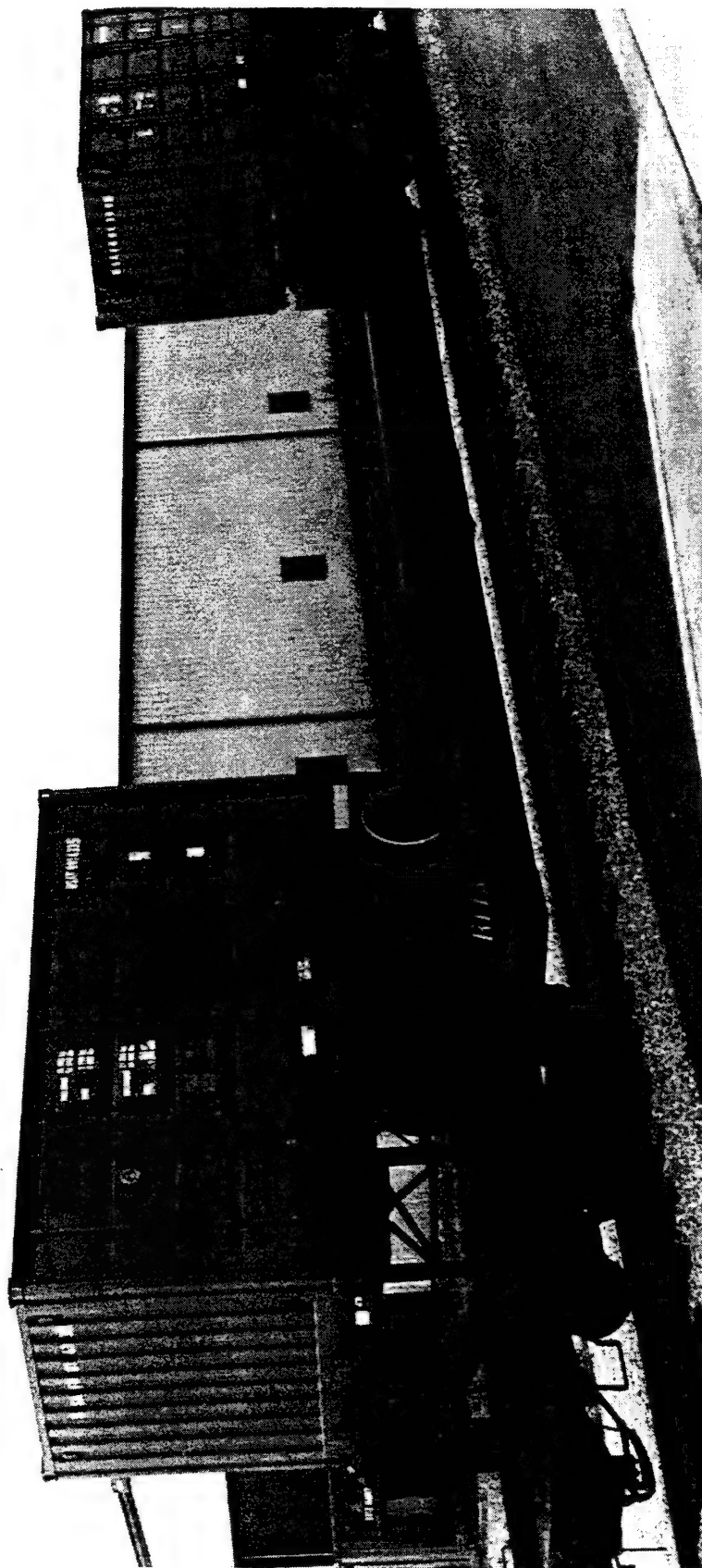
| | | |
|--|----------|---------|
| PASS 4-A OVER FIRST SERIES OF TIES: | 5.81 SEC | 5.9 MPH |
| PASS 4-B OVER SECOND SERIES OF TIES: | 6.13 SEC | 5.4 MPH |
| REMARKS: No lateral or visual vertical load or dunnage movement. | | |

WASHBOARD COURSE: No visual damage to the load or container.

80 DEGREE TILT TEST: No visual damage to the load or container.

PART 5

PHOTOGRAPHS



| | | |
|---|---|--|
| | U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNAH, IL | |
| PHOTO NO. SCN-94-186-2974. This photo shows a TOFC with two side-opening containers. The first container is loaded with 2,000-pound MK84 bomb complete rounds and the second container is loaded with 500-pound MK82 bombs. | | |



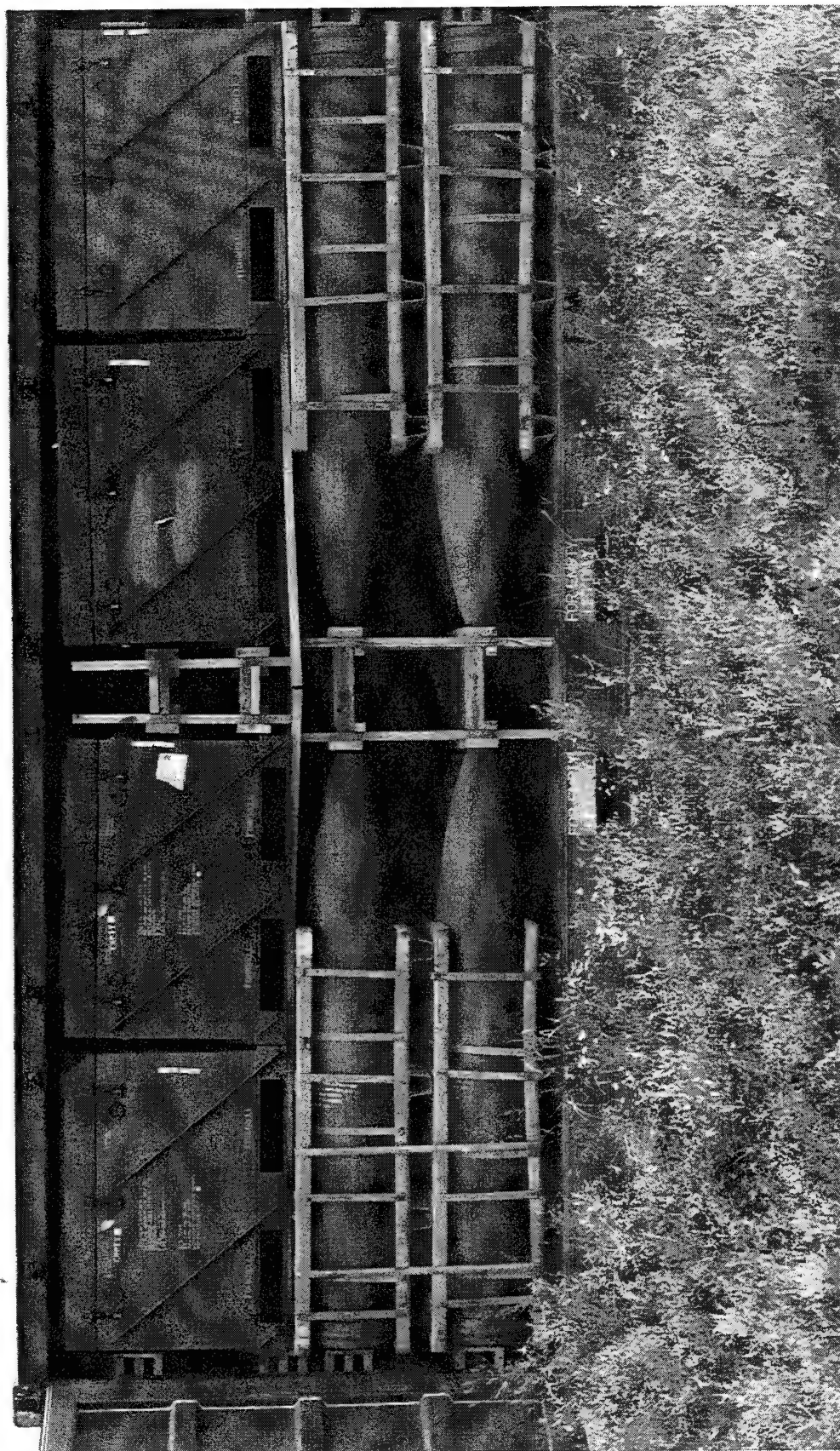
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|--|--|
| | U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL |
|--|--|

PHOTO NO. SCN-94-186-2981. This photo shows the container loaded with 2,000-pound MK84 bomb complete rounds being subjected to the 80 degree rotational tilt test. This test was performed after rail and road transportation tests. No shifting of the load occurred during this test.



| | | |
|--|---|--|
| | U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL | |
|--|---|--|

| |
|---|
| <p>PHOTO NO. SCN-94-186-2980. This photo shows the test setup used to rotate containers 80 degrees in the rotational test. The crane has a capacity of 40 tons. The container is tilted 80 degrees from its upright position. No load movement was observed after the test.</p> |
|---|



U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

PHOTO NO. SCN-94-186-2982. This photo shows the load of 2,000-pound MK84 bomb complete rounds. The bombs are on the lower layer and the other complete round components (fins, etc.) are located in the containers stowed above.

PART 6

DRAWING

REVISION NO. 1
APPROVED BY
BUREAU OF EXPLOSIVES

DATE _____

LOADING AND BRACING • WITH WOODEN DUNNAGE IN SIDE OPENING ISO CONTAINERS OF MK-84 (2,000 POUND) BOMBS, COMPLETE ROUND

- LOADING AND BRACING SPECIFICATIONS SET FORTH WITHIN THIS DRAWING ARE APPLICABLE TO LOADS THAT ARE TO BE SHIPPED BY TRAILER/CONTAINER-ON-FLATCAR (T/COFC) RAIL CARRIER SERVICE. THESE SPECIFICATIONS MAY ALSO BE USED FOR LOADS THAT ARE TO BE MOVED BY MOTOR OR WATER CARRIERS.

U.S. ARMY MATERIEL COMMAND DRAWING

APPROVED, U.S. ARMY ARMAMENT, MUNITIONS AND
CHEMICAL COMMAND

DRAFTSMAN

TECHNICIAN

ENGINEER

R. HAYNES

R. HAYNES

APPROVED BY ORDER OF COMMANDING GENERAL, U.S.
ARMY MATERIEL COMMAND

VALIDATION
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TRANSPORTATION
ENGINEERING
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LOGISTICS
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JANUARY 1993

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DRAWING

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19

48

7107

SP15M3

SEE THE REVISION LISTING ON PAGE 2

DO NOT SCALE

PROJECT SP 155-88

GENERAL NOTES

- A. THIS DOCUMENT HAS BEEN PREPARED AND ISSUED IN ACCORDANCE WITH AR 740-1 AND AUGMENTS TM 743-200-1 (CHAPTER 5).
- B. THE SPECIFIED OUTLOADING PROCEDURES ARE APPLICABLE TO LOADS OF MK-84 (2,000 POUND) BOMBS, COMPLETE ROUND. SEE PAGE 3 FOR DETAILS OF THE ITEMS TO BE SHIPPED. CAUTION: REGARDLESS OF THE QUANTITY OF CONTAINERS TO BE SHIPPED, THE "MAXIMUM GROSS WEIGHT" OF THE SIDE OPENING ISO CONTAINER MUST NOT BE EXCEEDED.
- C. THE LOAD AS SHOWN IS BASED ON A 6,050 POUND 20' LONG BY 8' WIDE BY 8'-6" HIGH SIDE OPENING INTERMODAL CONTAINER WITH INSIDE DIMENSIONS OF 19'-4" LONG BY 89" WIDE BY 88" HIGH. THE LOAD IS DESIGNED FOR TRAILER/CONTAINER-ON-FLAT-CAR (T/COFC) SHIPMENT. HOWEVER, THE LOAD AS DESIGNED CAN ALSO BE MOVED BY OTHER SURFACE MODES OF TRANSPORT. NOTICE: OTHER CONTAINERS OF THE SAME DESIGN CONFIGURATION CAN BE USED.
- D. WHEN LOADING CONTAINERS, THEY ARE TO BE POSITIONED SO AS TO ACHIEVE A TIGHT LOAD (TIGHT AGAINST THE DUNNAGE ASSEMBLIES). ALTHOUGH A TOTAL OF 1-1/2" OF UNBLOCKED SPACE ACROSS THE WIDTH OF A LOAD BAY IS PERMITTED, LATERAL VOIDS WITHIN THE LOAD ARE TO BE HELD TO A MINIMUM. EXCESSIVE SLACK CAN BE ELIMINATED FROM A LOAD BY LAMINATING ADDITIONAL PIECES OF APPROPRIATE THICKNESS TO THE HORIZONTAL PIECES ON THE CENTER GATE ASSEMBLY. NAIL EACH ADDITIONAL PIECE W/1 APPROPRIATELY SIZED NAIL EVERY 12". ADDITIONALLY, THE THICKNESS AND/OR QUANTITY OF THE VERTICAL AND HORIZONTAL PIECES IN THE CENTER GATE ASSEMBLY MAY BE ADJUSTED AS REQUIRED TO FACILITATE VARIANCE IN THE CONTAINER SIZE.
- E. DUNNAGE LUMBER SPECIFIED IS OF NOMINAL SIZE. FOR EXAMPLE, 1" X 4" MATERIAL IS ACTUALLY 3/4" THICK BY 3-1/2" WIDE AND 2" X 6" MATERIAL IS ACTUALLY 1-1/2" BY 5-1/2" WIDE.
- F. A STAGGERED NAILING PATTERN WILL BE USED WHENEVER POSSIBLE WHEN NAILS ARE DRIVEN INTO JOINTS OF DUNNAGE ASSEMBLIES OR WHEN LAMINATING DUNNAGE. ADDITIONALLY, THE NAILING PATTERN FOR AN UPPER PIECE OF LAMINATED DUNNAGE WILL BE ADJUSTED AS REQUIRED SO THAT A NAIL FOR THAT PIECE WILL NOT BE DRIVEN THROUGH ONTO OR RIGHT BESIDE A NAIL IN A LOWER PIECE.
- G. IN SOME CONTAINERS THERE IS A SLOT AT THE CORNERS OF THE ENDWALLS. PIECES OF DUNNAGE MATERIAL MUST BE LAMINATED TO THE BUFFER PIECES ON THE END BLOCKING ASSEMBLIES TO PROVIDE A FLAT SURFACE FOR THE BUFFER PIECES. A PIECE OF 2" X 4", 2" X 3" OR A SPECIAL WIDTH PIECE CUT-TO-FIT CAN BE USED. THIS FILL PIECE WILL BE NAILED WITH ONE APPROPRIATELY SIZED NAIL EVERY 12". THIS PIECE IS NOT REQUIRED WHEN THE CORNER PORTIONS OF THE CONTAINER ENDWALLS ARE SMOOTH AND FLAT.
- H. CAUTION: DO NOT NAIL DUNNAGE MATERIAL TO THE CONTAINER WALLS OR FLOOR. ALL NAILING WILL BE WITHIN THE DUNNAGE.
- J. PORTIONS OF THE CONTAINER DEPICTED WITHIN THIS DRAWING, SUCH AS THE SIDE DOORS, HAVE NOT BEEN SHOWN IN THE LOAD VIEWS FOR CLARITY PURPOSES.

(CONTINUED AT RIGHT)

MATERIAL SPECIFICATIONS

- LUMBER - - - - - : SEE TM 743-200-1 (DUNNAGE LUMBER) AND FED SPEC MM-L-751.
- NAILS - - - - - : FED SPEC FF-N-105; COMMON.
- PLYWOOD - - - - - : COMMERCIAL ITEM DESCRIPTION
A-A-55057, TYPE A, CONSTRUCTION AND
INDUSTRIAL PLYWOOD, INTERIOR WITH
EXTERIOR GLUE, GRADE C-D. IF
SPECIFIED GRADE IS NOT AVAILABLE, A
BETTER INTERIOR OR AN EXTERIOR GRADE
MAY BE SUBSTITUTED.
- WIRE, CARBON STEEL - : ASTM A853; ANNEALED AT FINISH, BLACK
OXIDE FINISH, .0800" DIA, GRADE 1005
OR BETTER.

(GENERAL NOTES CONTINUED)

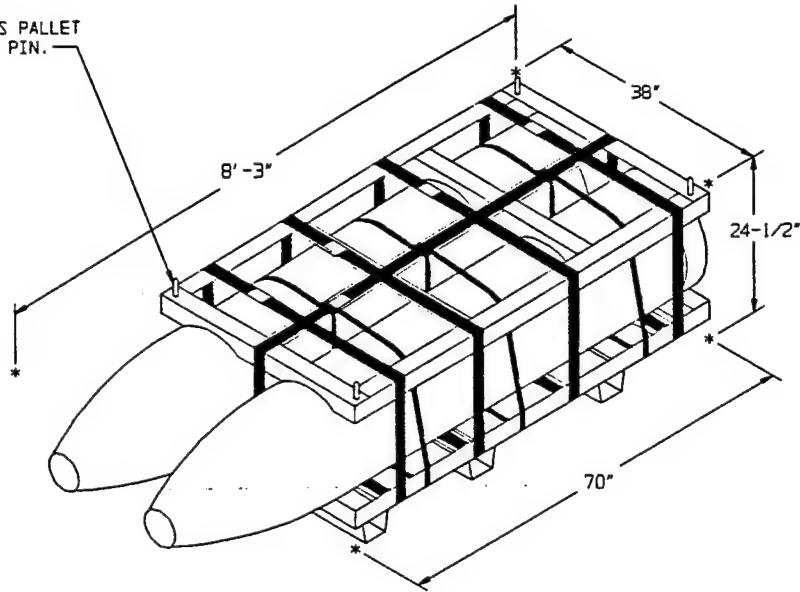
- K. REQUIREMENTS CITED WITHIN THE BUREAU OF EXPLOSIVES PAMPHLET 6C APPLY WHEN THE SHIPMENT MOVES BY TRAILER/CONTAINER-ON-FLAT-CAR (T/COFC). SPECIAL T/COFC NOTES FOLLOW:
1. A LOADED CONTAINER MUST BE ON A CHASSIS EQUIPPED WITH TWO BOGIE ASSEMBLIES WHEN BEING MOVED IN TOFC SERVICE.
 2. THE LOAD LIMIT OF A T/COFC RAILCAR MUST NOT BE EXCEEDED, NOR WILL A CAR BE LOADED SO THAT THE TRUCK UNDER ONE END OF THE CAR CARRIES MORE THAN ONE-HALF OF THE LOAD LIMIT FOR THAT CAR.
- L. DURING INTRASTATE AND/OR INTERSTATE MOVES BY MOTOR CARRIER, A PROPER CHASSIS OR MODIFIED FLATBED TRAILER MUST BE USED TO PRECLUDE VIOLATION OF ONE OR MORE "WEIGHT LAWS" APPLICABLE TO THE STATE OR STATES INVOLVED.
- M. CONVERSION TO METRIC EQUIVALENTS: DIMENSIONS WITHIN THIS DOCUMENT ARE EXPRESSED IN INCHES AND WEIGHTS ARE EXPRESSED IN POUNDS. WHEN NECESSARY, THE METRIC EQUIVALENTS MAY BE COMPUTED ON THE BASIS OF ONE INCH EQUALS 25.4MM AND ONE POUND EQUALS 0.454KG.

REVISION

REVISION NO. 1, DATED JUNE 1994 CONSISTS OF:

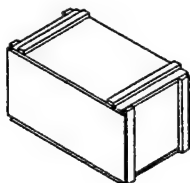
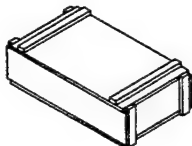
1. ADDING PROCEDURES FOR A 16-UNIT LOAD.

INDICATES PALLET
STACKING PIN.



2000 POUND, MK84

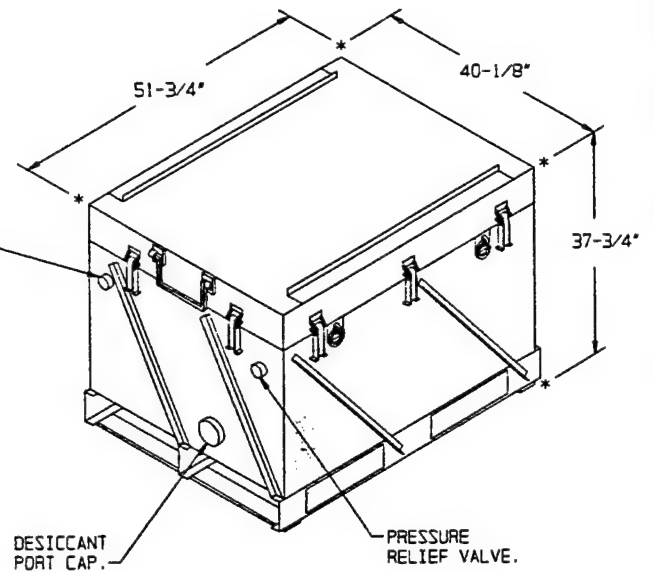
BOMB - - - - - 2 EACH @ 1,930 LBS (APPROX)
CUBE - - - - - 55.5 CU. FT. (APPROX)
GROSS WEIGHT - - - 4,133 LBS (APPROX)



TYPICAL COMPONENT BOXES

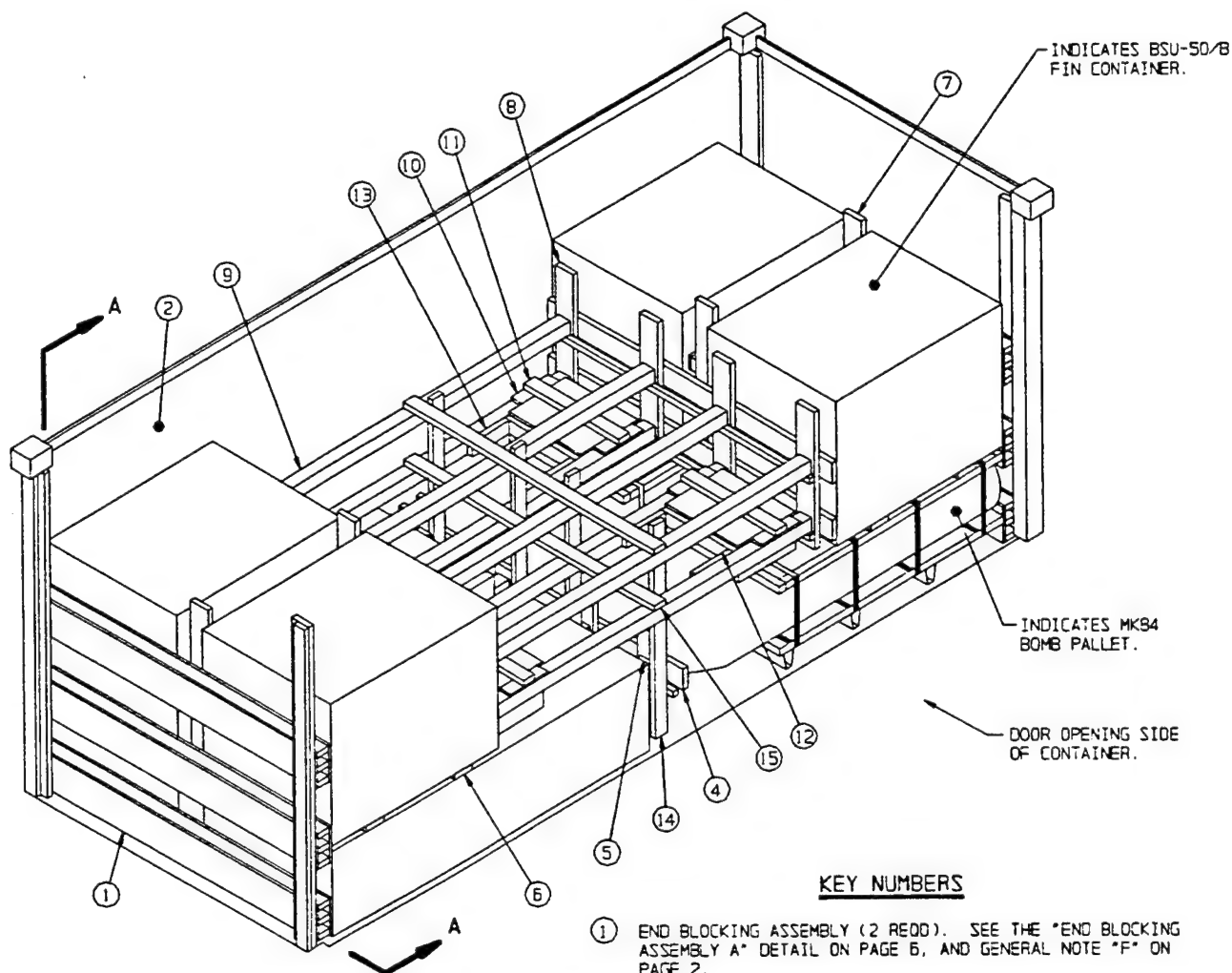
VARIOUS SIZES AND WEIGHTS.

HUMIDITY
INDICATOR.

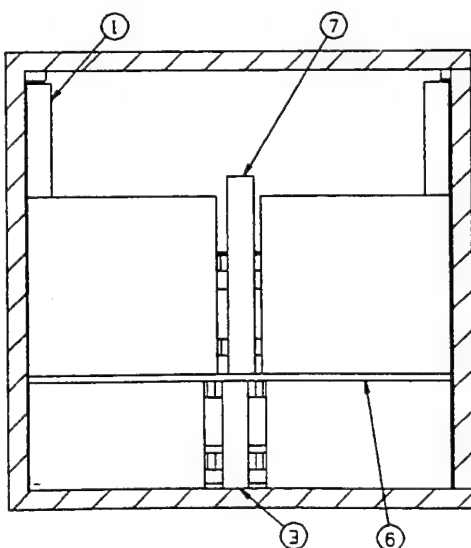


ISOMETRIC VIEW

(CNU-335 A/E CNTR) - - 1,038 LBS (APPROX)
CUBE - - - - - 45.4 CU FT (APPROX)



ISOMETRIC VIEW



SECTION A-A

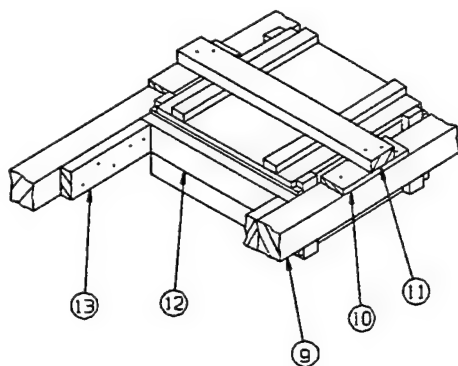
KEY NUMBERS

- ① END BLOCKING ASSEMBLY (2 REOD). SEE THE "END BLOCKING ASSEMBLY A" DETAIL ON PAGE 6, AND GENERAL NOTE "F" ON PAGE 2.
- ② SIDEWALL LINER, PLYWOOD, 3/8" THICK (AS REOD). POSITION SO AS TO BE BETWEEN THE LADING AND THE CONTAINER SIDEWALL OR THE CONTAINER DOORS, AS APPLICABLE.
- ③ CRIB FILL (2 REOD). SEE THE "CRIB FILL A" DETAIL ON PAGE 6. POSITION BETWEEN THE PALLET UNITS OF BOMBS. SEE GENERAL NOTE "D" ON PAGE 2.
- ④ CENTER GATE (2 REOD). SEE THE "CENTER GATE A" DETAIL ON PAGE 7. POSITION BETWEEN THE PALLET UNITS OF BOMBS.
- ⑤ STRUT "A", 4" X 4" BY CUT TO FIT (REF: 12-3/4") (8 REOD). POSITION SO AS TO BE BETWEEN THE CENTER GATES, PIECES MARKED ④. TOENAIL TO THE CENTER GATES W/2-15d NAILS AT EACH END.
- ⑥ DECKING, 2" X 6" BY LENGTH TO SUIT (REF: 7'-4") (4 REOD). WIRE TIE TO THE TOP FRAME OF THE BOMB PALLET UNITS.
- ⑦ CRIB FILL (2 REOD). SEE THE "CRIB FILL B" DETAIL ON PAGE 6. POSITION BETWEEN THE CONTAINERS IN THE SECOND LAYER.
- ⑧ CENTER GATE (2 REOD). SEE THE "CENTER GATE B" DETAIL ON PAGE 7. POSITION AS SHOWN AGAINST THE CONTAINERS IN THE SECOND LAYER.
- ⑨ STRUT "B", 4" X 4" BY CUT TO FIT (REF: 9'-0-1/4") (8 REOD). POSITION SO AS TO BE BETWEEN THE CENTER GATES, PIECES MARKED ⑨. TOENAIL TO THE CENTER GATES W/2-16d NAILS AT EACH END.
- ⑩ FILLER, 1" X 4" X 12" (AS REOD). POSITION ON TOP OF AND NAIL TO THE STRUT W/2-6d NAILS. SEE SPECIAL NOTE 2 ON PAGE 5.
- ⑪ HOLD DOWN, 2" X 4" X 30" (AS REOD, 1 PER BOX). CENTER ON BOX AND NAIL THROUGH PIECE MARKED ⑩ INTO STRUT W/2-10d NAILS AT EACH END.

(CONTINUED ON PAGE 5)

(KEY NUMBERS CONTINUED FROM PAGE 4)

- ⑫ CROSS BLOCKING, 2" X 4" BY CUT TO FIT BETWEEN STRUTS (1 REQD PER BOX).
- ⑬ CLEAT, 2" X 4" X 12" (2 REQD PER BOX). POSITION AS SHOWN AND NAIL TO THE STRUT, PIECE MARKED ⑨, W/4-10d NAILS. TOENAIL TO CROSS BLOCKING W/1-12d NAIL.
- ⑭ VERTICAL STRUT BRACING, 2" X 4" BY LENGTH TO SUIT (4 REQD). NAIL TO THE STRUTS, PIECES MARKED ⑨, W/2-10d NAILS AT EACH JOINT.
- ⑮ HORIZONTAL STRUT BRACING, 2" X 4" BY LENGTH TO SUIT (2 REQD). NAIL TO THE STRUTS, PIECES MARKED ⑨, W/2-10d NAILS AT EACH JOINT.



SECUREMENT OF MISCELLANEOUS BOXES

| BILL OF MATERIAL | | |
|-------------------|----------------|------------|
| LUMBER | LINEAR FEET | BOARD FEET |
| 1" X 4" | 44 | 15 |
| 2" X 2" | 41 | 14 |
| 2" X 4" | 173 | 115 |
| 2" X 6" | 292 | 292 |
| 4" X 4" | 81 | 108 |
| NAILS | NO. REQD | POUNDS |
| 6d (2") | 464 | 2-3/4 |
| 10d (3") | 376 | 5-3/4 |
| 12d (3-1/4") | 8 | NIL |
| 16d (3-1/2") | 64 | 1-1/4 |
| WIRE, NO. 14 GAGE | 12' REQD | NIL |
| PLYWOOD, 3/4" | 56 SQ FT REQD | 116 LBS |
| PLYWOOD, 3/8" | 277 SQ FT REQD | 285 LBS |

SPECIAL NOTES:

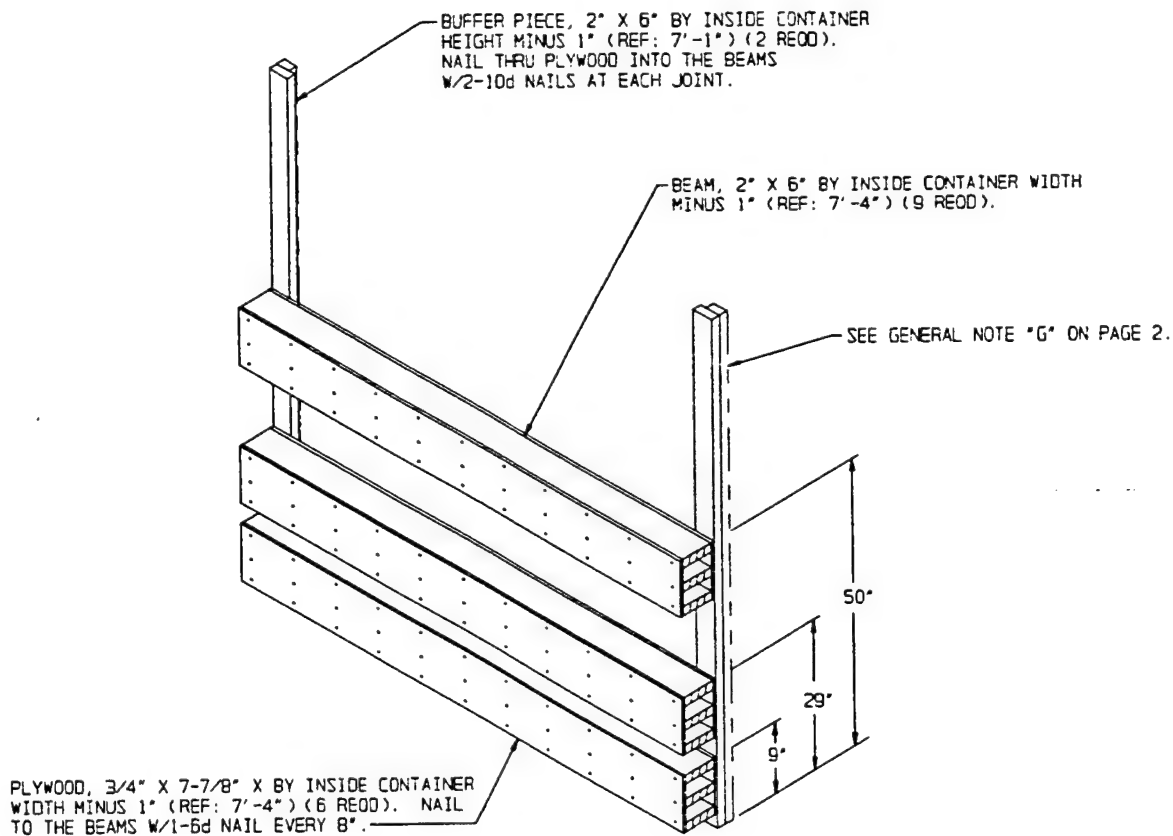
1. THE LOAD AS SHOWN ON PAGE 4 DEPICTS A COMPLETE ROUND LOAD OF 2,000 POUND MK-84 BOMBS, INCLUDING 4 PALLETS OF BOMBS, 4 CNU 335-A/E CONTAINERS WITH BSU-50/B FINS, 4 BOXES CONTAINING MISCELLANEOUS ITEMS SUCH AS FUZES, ADAPTORS, AND COUPLERS.
2. WHEN INSTALLING THE DUNNAGE THAT APPLIES TO THE MISCELLANEOUS BOXES, ADJUSTMENTS TO THE QUANTITY AND SIZE OF MATERIAL MAY BE ADJUSTED AS NECESSARY.

| TYPICAL ITEMS AS DEPICTED ON PAGE 4 | | |
|-------------------------------------|----------------------|----------|
| DODIC | NOMENCLATURE | QUANTITY |
| G212 | M9 NON DELAY FUZE | 8 |
| F989 | M905 TAIL FUZE | 8 |
| M187 | CTG, ARD 446-1 | 8 |
| M189 | CTG, ARD 863-1 | 8 |
| F491 | MAU-86/B/3 SHAFT | 8 |
| F387 | ADAPTER, BOOST TAIL | 8 |
| F275 | MK84 BOMB, 2000 LB | 8 |
| BY31 | ARM WIRE BULK | 64' |
| EY21 | FERRULE | 16 |
| BY29 | ATU-35/B DRIVE ASSY | 8 |
| CY72 | SWIVEL & LINK ASSY | 16 |
| EY91 | MAU-87 DRIVE COUPLER | 8 |
| F746 | FMU 113 FUZE | 8 |
| GY26 | BSU-50/B FIN | 8 |

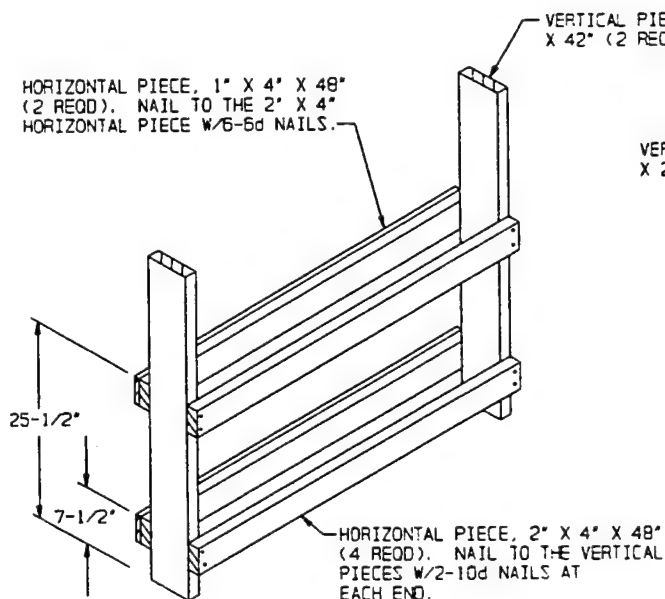
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| ITEM | QUANTITY | WEIGHT (APPROX) |
|---------------------|----------|-----------------|
| MK 84 BOMB PALLET | 4 | 16,532 LBS |
| BSU-50/B FIN | 8 | 2,236 LBS |
| MISCELLANEOUS ITEMS | 4 BOXES | 200 LBS |
| DUNNAGE | | 1,500 LBS |
| CONTAINER | | 6,050 LBS |

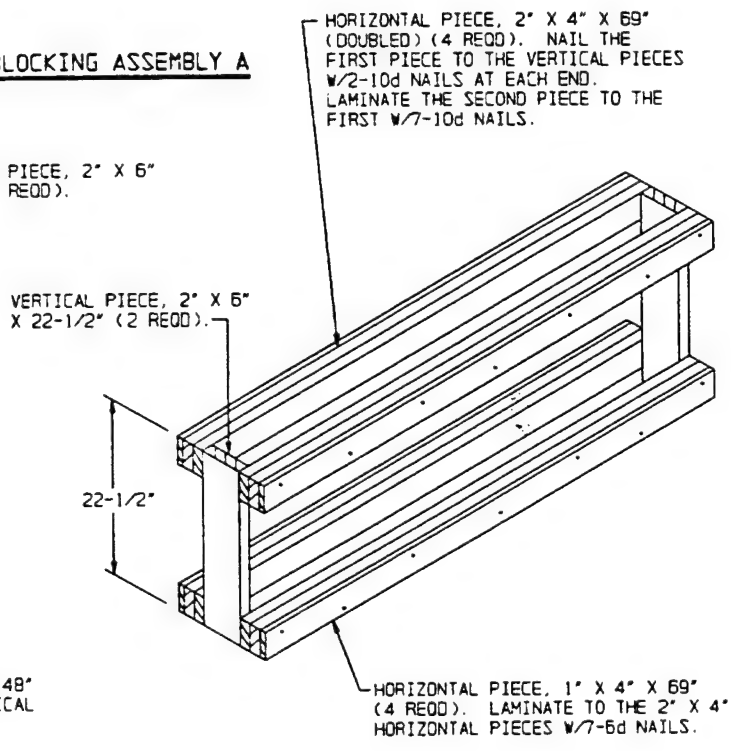
TOTAL WEIGHT - - - - - 26,518 LBS (APPROX)



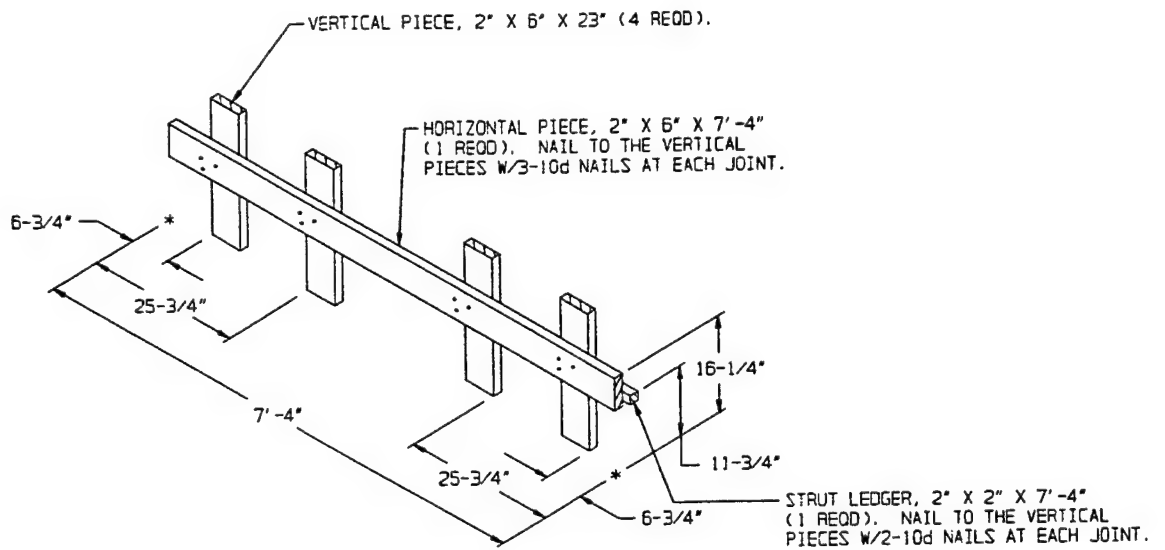
END BLOCKING ASSEMBLY A



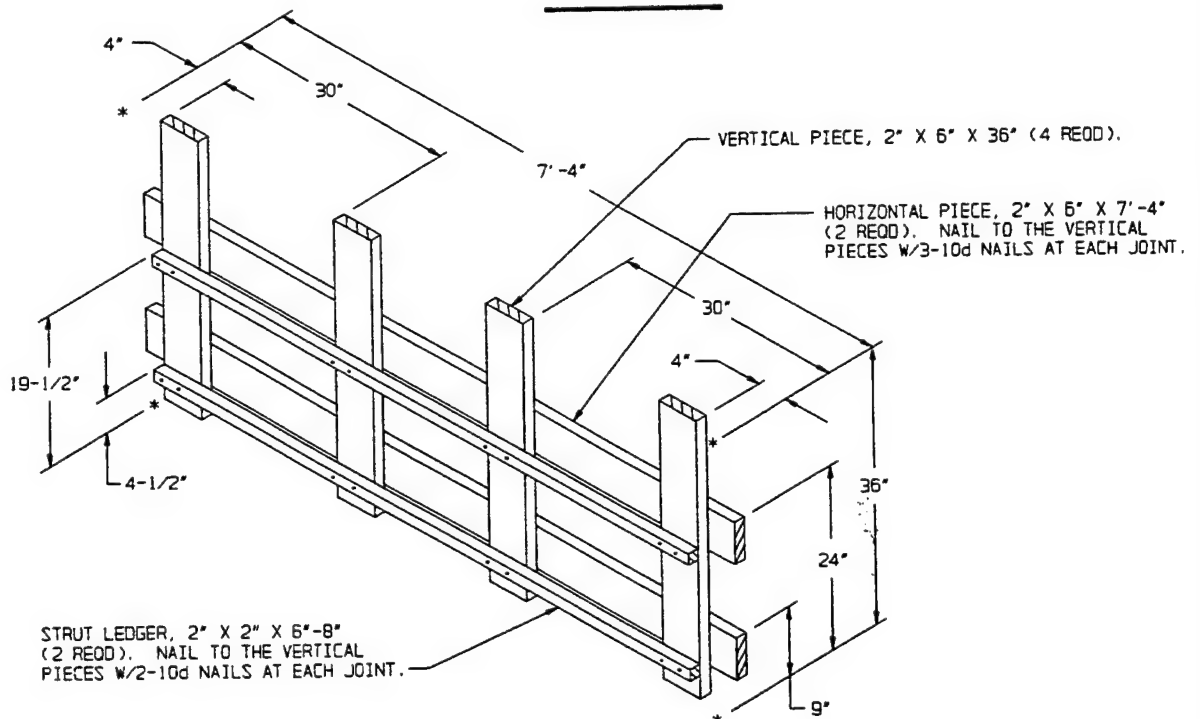
CRIB FILL B



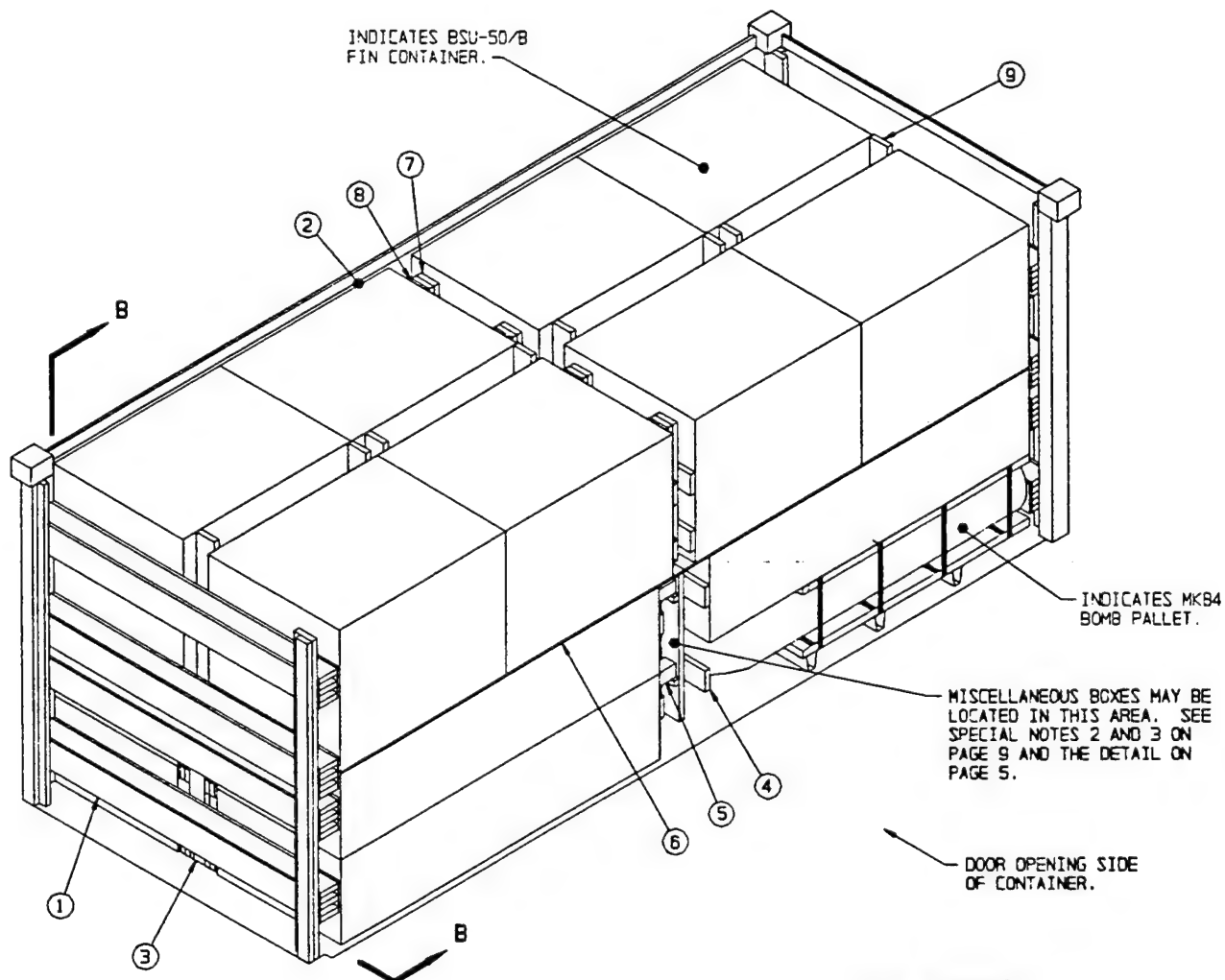
CRIB FILL A



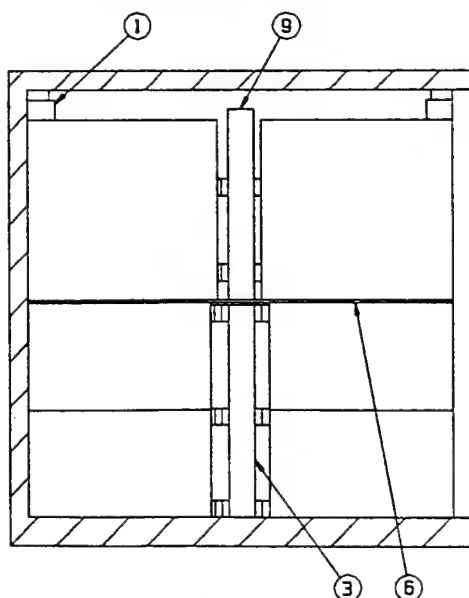
CENTER GATE A



CENTER GATE B



ISOMETRIC VIEW



SECTION B-B

KEY NUMBERS

- ① END BLOCKING ASSEMBLY (2 REQD). SEE THE "END BLOCKING ASSEMBLY B" DETAIL ON PAGE 12, AND GENERAL NOTE "F" ON PAGE 2.
- ② SIDEWALL LINER, PLYWOOD, 3/8" THICK (AS REQD). POSITION SO AS TO BE BETWEEN THE LADING AND THE CONTAINER SIDEWALL OR THE CONTAINER DOORS, AS APPLICABLE.
- ③ CRIB FILL (2 REQD). SEE THE "CRIB FILL C" DETAIL ON PAGE 11. POSITION BETWEEN THE PALLET UNITS OF BOMBS. SEE GENERAL NOTE "D" ON PAGE 2.
- ④ CENTER GATE (4 REQD). SEE THE "CENTER GATE C" DETAIL ON PAGE 10. POSITION BETWEEN THE PALLET UNITS OF BOMBS.
- ⑤ STRUT, 4" X 4" BY CUT TO FIT (REF: 12-3/4") (8 REQD). POSITION SO AS TO BE BETWEEN THE CENTER GATES, PIECES MARKED ④. TOENAIL TO THE CENTER GATES W/2-16d NAILS AT EACH END.
- ⑥ DECKING, PLYWOOD, 1/2" THICK BY 44" WIDE BY 8'-0" LONG (4 REQD). POSITION ON TOP OF THE BOMB PALLET UNITS. NOTE THAT HOLES MAY BE DRILLED OR CUT TO ALLOW FOR THE PALLET STACKING PINS.
- ⑦ CENTER GATE (4 REQD). SEE THE "CENTER GATE D" DETAIL ON PAGE 10. POSITION BETWEEN THE CONTAINERS IN THE THIRD LAYER.
- ⑧ SOLID FILL, 6" WIDE MATERIAL BY 36" LONG BY THICKNESS AS REQUIRED SO AS TO PROVIDE FOR A TIGHT LOAD. SEE GENERAL NOTE "D" ON PAGE 2.
- ⑨ CRIB FILL (4 REQD). SEE THE "CRIB FILL D" DETAIL ON PAGE 11. POSITION BETWEEN THE CNU-335 A/E CONTAINERS.

SPECIAL NOTES:

1. THE LOAD AS SHOWN ON PAGE 8 DEPICTS A COMPLETE ROUND LOAD OF 2,000 POUND MK-84 BOMBS, INCLUDING 8 PALLETS OF BOMBS, 8 CMU-335 A/E CONTAINERS WITH BSU-50 FINS, 5 BOXES CONTAINING MISCELLANEOUS ITEMS SUCH AS FUZES, ADAPTORS, COUPLERS, ETC. SEE THE CHARTS BELOW FOR TYPICAL ITEMS.
2. MISCELLANEOUS BOXES MAY BE PLACED IN THE AREA BETWEEN THE CENTER GATES "C" AND SECURED AS SHOWN IN THE "SECUREMENT OF MISCELLANEOUS BOXES" DETAIL ON PAGE 5.
3. WHEN INSTALLING THE DUNNAGE THAT APPLIES TO THE MISCELLANEOUS BOXES, ADJUSTMENTS TO THE QUANTITY AND SIZE OF MATERIAL MAY BE ADJUSTED AS NECESSARY.

| TYPICAL ITEMS AS DEPICTED ON PAGE 8 | | |
|--|-------------------|----------|
| DODIC | NOMENCLATURE | QUANTITY |
| F275 | MK 84 BOMB PALLET | 8 |
| GY26 | BSU 50 FIN | 16 |
| F835 | M904 FUZE | 30 |
| G119 | FMU 139 FUZE | 18 |
| F372 | T-45 ADAPTOR | 30 |
| G212 | M9 NON-DELAY FUZE | 240 |

| TYPICAL ITEMS FOR MK 84 AIR BURST (NOT SHOWN) * | | |
|--|--------------------|----------|
| DODIC | NOMENCLATURE | QUANTITY |
| F275 | MK 84 BOMB PALLET | 8 |
| GY26 | BSU 50 FIN | 16 |
| F746 | FMU 113 FUZE | 16 |
| F989 | M905 FUZE | 30 |
| BY29 | ATU-35 DRIVE | 120 |
| EY91 | MAU 87 COUPLER | 120 |
| F491 | MAU 86 B3 SHAFT | 316 |
| F387 | M147 ADAPTOR | 30 |
| G212 | M-9 NON-DELAY FUZE | 240 |

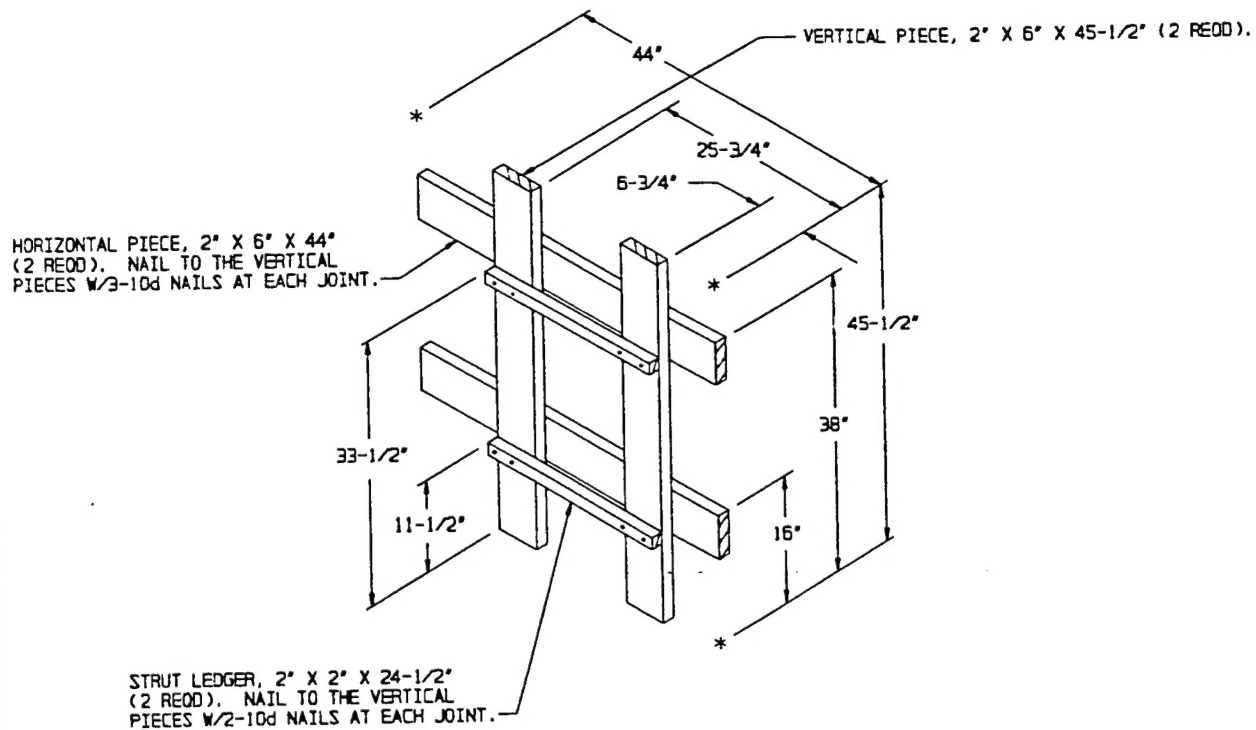
* MK 84 AIR BURST LOAD WILL BE LOADED USING THE PROCEDURES SHOWN ON PAGE 8. ADDITIONAL COMPONENTS WILL BE SECURED BETWEEN THE CENTER GATES AND/OR IN VOID AREA BETWEEN LATERALLY ADJACENT PALLET UNITS.

| BILL OF MATERIAL | | |
|------------------|----------------|------------|
| LUMBER | LINEAR FEET | BOARD FEET |
| 1" X 4" | 101 | 34 |
| 2" X 2" | 17 | 6 |
| 2" X 4" | 202 | 135 |
| 2" X 6" | 419 | 419 |
| 4" X 4" | 9 | 12 |
| NAILS | NO. REQD | POUNDS |
| 6d (2") | 594 | 3-1/2 |
| 10d (3") | 408 | 6 |
| 16d (3-1/2") | 32 | 3/4 |
| PLYWOOD, 3/8" | 320 SQ FT REQD | 330 LBS |
| PLYWOOD, 1/2" | 118 SQ FT REQD | 162 LBS |
| PLYWOOD, 3/4" | 77 SQ FT REQD | 159 LBS |

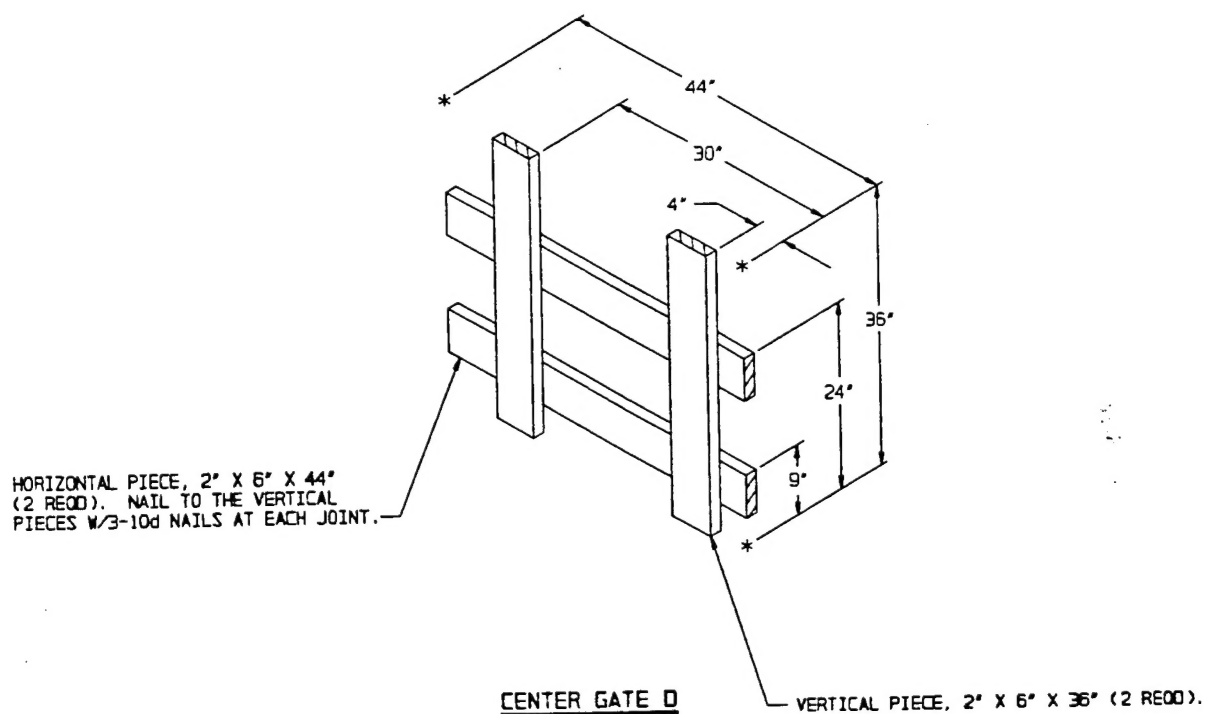
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| ITEM | QUANTITY | WEIGHT (APPROX) |
|---------------------|----------|-----------------|
| MK 84 BOMB PALLET | 8 | 33,064 LBS |
| BSU-50 FIN | 16 | 8,304 LBS |
| MISCELLANEOUS ITEMS | 5 BOXES | 300 LBS |
| DUNNAGE | | 1,875 LBS |
| CONTAINER | | 6,050 LBS |

TOTAL WEIGHT - - - - - 49,593 LBS (APPROX)



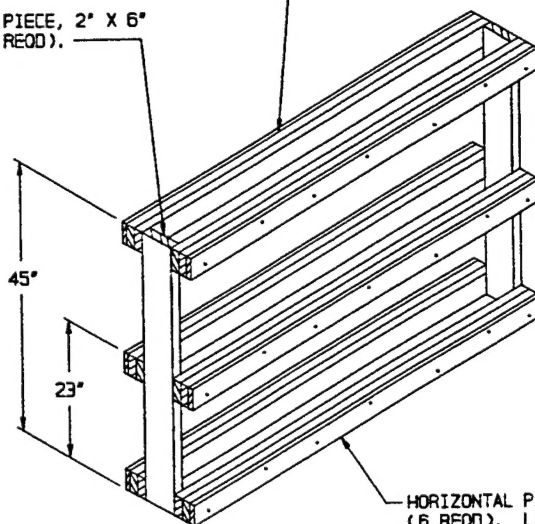
CENTER GATE C



CENTER GATE D

VERTICAL PIECE, 2" X 6"
X 45" (2 REOD).

HORIZONTAL PIECE, 2" X 4" X 69"
(DOUBLED) (6 REOD). NAIL THE
FIRST PIECE TO THE VERTICAL PIECES
W/2-10d NAILS AT EACH END.
LAMINATE THE SECOND PIECE TO THE
FIRST W/7-10d NAILS.

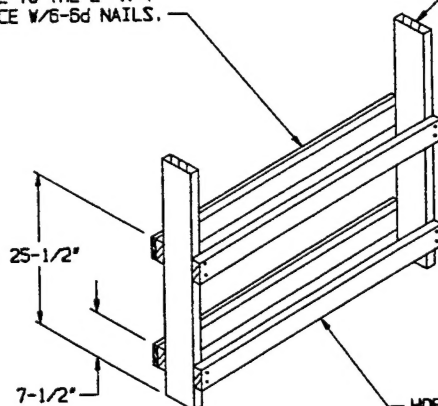


HORIZONTAL PIECE, 1" X 4" X 69"
(6 REOD). LAMINATE TO THE 2" X 4"
HORIZONTAL PIECES W/7-6d NAILS.

CRIB FILL C

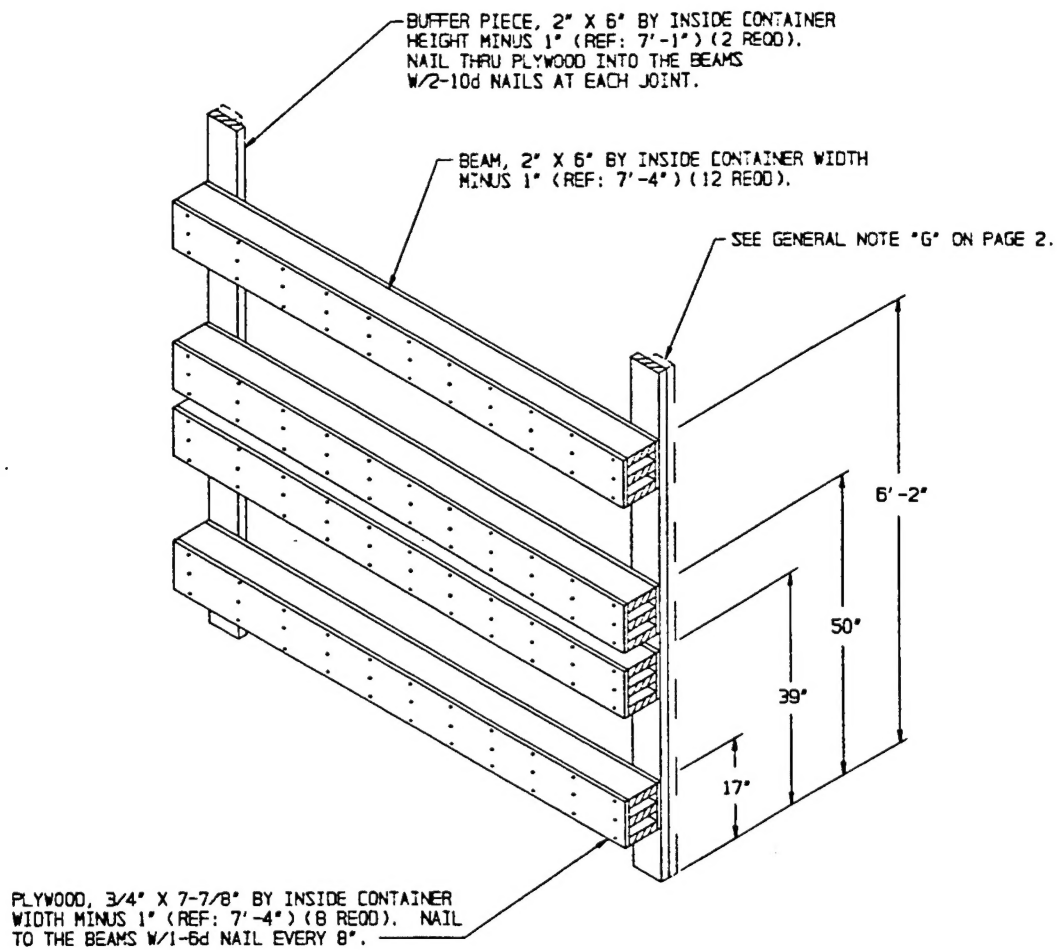
HORIZONTAL PIECE, 1" X 4" X 48"
(2 REOD). NAIL TO THE 2" X 4"
HORIZONTAL PIECE W/6-6d NAILS.

VERTICAL PIECE, 2" X 6"
X 40" (2 REOD).



HORIZONTAL PIECE, 2" X 4" X 48"
(4 REOD). NAIL TO THE VERTICAL
PIECES W/2-10d NAILS AT EACH END.

CRIB FILL D



END BLOCKING ASSEMBLY B